Munich Satellite Navigation Summit 2007 • Institute of Geodesy and Navigation • University FAF Munich • 85577 Neubiberg / Germany

MUNICH SATELLITE NAVIGATION SUMMIT 2007:

Session 9: Is (Or Will Be) The Russian Glonass System Interoperable With The Other GNSS

The chairman, John Betz, MITRE, started session 9 calling to mind some statements made on Glonass and Compass during the Summit. The fundamental difference concerning Glonass is the use of FDMA (Frequency Division Multiple Access) instead of CDMA (Code-Division Multiple Access) utilised by the other systems.
Betz gave the definition of interoperability taken from the EU-US Agreement from 2004. He differenced between interoperability and compatibility. Compatibility refers to the fact that the systems don't disturb each other. Interoperability means that all systems together deliver more value than one alone. Of course, there are different levels of interoperability. He admitted to the floor the first panellist to start the presentations on the interoperability followed by a discussion.

Victor E. Kosenko, Deputy General Constructor, Research and Production Association of Applied Mechanics, initiated with his own definition of interoperability. According to his understanding, interoperability is the ability of Global Navigation Satellite systems having independent control loop to operate jointly with other systems without interfering.
Interoperability refers to the following three aspects: coordinate reference, time coordination to UTC and signals. A decision to accommodate new Glonass signals is going to expect this year. At Kosenko's point of view GPS/GLONASS interoperability is already ensured at the receiver level for many applications.

Moreover, he continued talking about the programs to ensure and improve accuracy and performance parameters for modernised GLONASS by 2011. The goal is to achieve a performance equivalent to that of GPS and future Galileo.
Kosenko described the five basic parts that comprise the activities to be carried out between 2006 and 2011:
- orbital group deployment
- improvement of Glonass navigation field accuracy
- ensuring and improvement of navigation field availability
- ensuring of navigation field integrity
- modernisation of navigation signals.

Finally, he sowed some figures on the expected global availability. At the moment global availability of Glonass is of about 72.5 % and is planned to be increased to 99.97 % in 2010.

Godet, Shilov, Kosenko, Tyulyakov, Karutin, Hatch, Betz (left to right)

The next panellist, Arkadiy E. Tyulyakov, Deputy Director, Russian Institute for Radionavigation and Time, gave a presentation on time interoperability. At the beginning general tasks on Glonass time were given. It was emphasised that the national coordinated time scale of Russia

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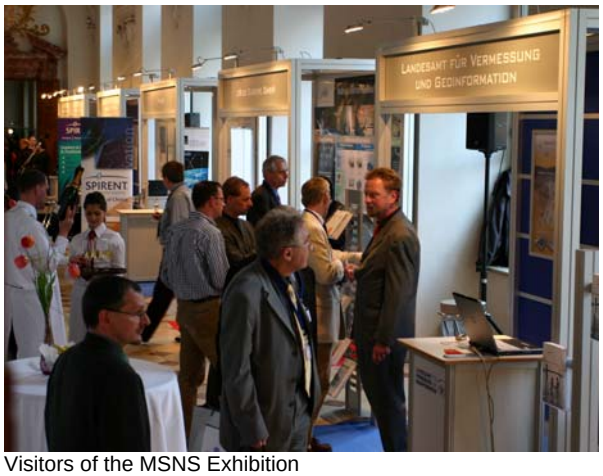
UTC (SU) formed by the State Time and Frequency Reference (STFR) will be used as a reference time scale for Glonass.
Tyulyakov continued talking on the planned Glonass system time stability and on-board clock stability. Time realisation in orbit is expected to improve by a factor of five. In addition the Russian vision on GNSS Time Interoperability was presented. With respect to GPS time coordination is planned to be improved from 30 ns to 2-6 ns and regarding UTC (SU) an improvement of the time coordination is expected to go from 1000 ns to 4-8 ns.

Sergey N. Karutin, Deputy Head of Satellite Navigation Division, Russian Institute of Space Device Engineering, began giving a brief overview on the Glonass development talking about ground segment modernisation, signal system upgrade and augmentations development.
Referring to interoperability and evolution Karutin said that changing things is possible but “with signals it is different. We have to think with mind in the future”.
Finally the SDCM (System of Differential Correction and Monitoring) as augmentation for Glonass was proposed.



Visitors of the MSNS Exhibition

Dr. Ronald Hatch, Director of Navigation Systems Engineering, Principal and co-founder of NavCom Technology, Inc., mentioned the US-Russia results of Working Group 1. As he remarked, both sides had noted the importance of real interoperability among the different GNSS systems. He continued his presentation giving an assessment of FDMA versus CDMA with the conclusions:
1. FDMA generally entails a more costly hardware realisation
2. FDMA measurement quality is generally less than CDMA measurement quality
3. Multiple wavelengths of carrier phase using FDMA complicates the measurement processing, particularly for high accuracy carrier-phase applications

Session 9 continued with Dr. Stuart Riley, Director Receiver Development, GPS Engineering and Construction Group, Trimble, who demonstrated the Trimble view on Glonass. Three generations of Glonass receiver technology have been presented so far, although the first never came to light. Moreover, he talked about the cost and technical complexity as barriers for a real interoperability in the case of Glonass. In fact, the main interoperability problem is that GPS and Glonass don’t have the signals in the same bands.
Riley moved to performance comparison, giving some figures on orbital accuracy, multipath, integrity and Glonass health issues. In this regard, Glonass has some important drawbacks in its current configuration. Nevertheless, he recognised that Glonass adds extra availability in areas of limited sky visibility and can improve RTK performance compared to GPS only.
He closed the presentation by hypothesising on future receivers.

The last panellist, Jeremie Godet, Galileo Unit, European Commission, exposed the Galileo program’s point of view on what interoperability is. He gave clear statements on the different levels of interoperability that can be achieved. In addition, Godet talked about vulnerability as a crucial factor to take

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into account in these discussions also. Moreover, he included as important factors the compatibility, simplicity of the user segment (receiver design), market considerations/economic aspects, independence and security.
He continued proposing a list of categories to judge the level of interoperability between two systems, regarding signal in space (which comprises codes, frequencies, modulation and navigation message), time reference frame and coordinate reference frame. Emanating from this table, GPS and Galileo would only differ in codes and messages. GPS and QZSS would be completely interoperable and between GPS and GLONASS there would be no real interoperability according to his understanding.
Godet summarised the efforts made on the EU side to discuss compatibility and interoperability with Glonass. If Glonass moves to CDMA the conversations should be reestablished again. He showed some technical aspects of interoperability between Galileo and Glonass from studies in the past on the E5 band.
Godet concluded with a vision that Glonass will has moved to CDMA. Other mixed scenarios were also taken into consideration, whereas Glonass would have both FDMA and CDMA.

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